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Pseudobankesia keersmaekersi sp. n., a new species from Greece (Lepidoptera, Psychidae, Taleporiinae)

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Abstract. *Pseudobankesia keersmaekersi* **sp. n**. (Lepidoptera, Psychidae, Taleporiinae) is described from Greece and compared with its likely close relatives *Pseudobankesia arahova* Stengel, 1990 and *Pseudobankesia darwinii* Stengel, 1990. The new species is well characterized by its remarkably coloured forewings and wing-pattern and the unusually large larval cases.

Samenvatting. *Pseudobankesia keersmaekersi* **sp. n.** (Lepidoptera, Psychidae, Taleporiinae) wordt van Griekenland beschreven. Ze wordt vergeleken met de wellicht erg nauw aanverwante soorten *Pseudobankesia arahova* Stengel, 1990, en *Pseudobankesia darwinii* Stengel, 1990. De nieuwe soort wordt gekenmerkt door de opvallende kleur en tekening van de voorvleugel, bovendien hebben de larven buitengewoon grote larvenkokers.

Zusammenfassung. *Pseudobankesia keersmaekersi* **sp. n.** (Lepidoptera, Psychidae, Taleporiinae) wird aus Griechenland beschrieben und mit den vermutlich nächstverwandten *Pseudobankesia arahova* Stengel, 1990, und *Pseudobankesia darwinii* Stengel, 1990, verglichen. Die neue Art ist gekennzeichnet durch die auffällige Farbe der Vorderflügel und ihre Flügelzeichnung sowie durch die ungewöhnlich großen Säcke der Larven.

Introduction

The genus *Pseudobankesia* Meier, 1963 (Lepidoptera, Psychidae, Taleporiinae) contains 15 species in the Palaearctic Region. Fourteen of them are distributed from Portugal eastwards to Cyprus (Sobczyk 2012; Arnscheid and Weidlich in press). Most species inhabit rocks and walls in mountainous areas where they occur up to 2500 m in the Alps. Eight species have been described from south-eastern Europe: *P. macedoniella* (Rebel, 1920) from Macedonia; *P. kresnensis* Weidlich, 2014 from Bulgaria; *P. arahova* Stengel, 1990, *P. darwinii* Stengel, 1990, and *P. lichenaria* Weidlich, 2016 from Greek mainland and Peloponnes; *P. hauseriella* Henderickx, 1998 from Crete; and *P. aphroditae* Weidlich & Henderickx, 2002 from Cyprus. *P. dioszeghyi* (Rebel, 1935), which is known only from the holotype, has been described from Romania. After examination of the holotype (deposited at the Hungarian National History Museum Budapest, Hungary) in 2014, WA came to the conclusion that it is more than questionable that this specimen belongs to *Pseudobankesia*.

During his expeditions to Greece, HH discovered along with other psychids a lot of cases with larvae of a remarkable *Taleporiinae* species from which he reared one male and several females. The flight period of this species is in the second half of November through December. The larval cases were all found under lava rocks, never on walls or on the exposed surface of stones.

Comparing this material with the likely closely related taxa, as well as a subsequent analysis of the adult morphology including the male genitalia structures, supported the recognition of a new species, which is herewith introduced to science as *Pseudobankesia keersmaekersi* sp. n.

Pseudobankesia was separated from the related *Bankesia* Tutt, 1899 by Meier (1963) based on differences in the antennae of both sexes and in the male genitalia. The male genitalia of *Pseudobankesia* resemble those of *Taleporia* Hübner, 1825, which were illustrated by de Freina and Witt (1984), but the cases of *Taleporia* and *Pseudobankesia* are very different, and therefore these taxa are not congeneric as considered by de Freina and Witt (1984).

Material and methods

Figures 1a, b, c, and d were made with a Canon 5D mark III and MP-E 65 macro lens, with soft flash illumination. Figures 1a and 1b were stacked by using Zerene Stacker software. Figures 2a and 2b were taken from preparations in Euparal with an Olympus stereo microscope using a Pentax digital camera and stacked by CombineZP Stacker software. Figures 3a and b were made with an Olympus E1 digital camera and 35 mm macro objective.

We used DNA barcodes (a region of 658 base pairs of the mitochondrial cytochrome c oxidase I, also known as COI) from seven *Pseudobankesia* species (one represented by two specimens) and two *Bankesia* species (one also represented by two specimens) as a tool to help us better understand the taxonomy of *Pseudobankesia*. DNA sequencing of the DNA barcode was carried out at the Biodiversity Institute of Ontario, University of Guelph in 2015 and 2016 and it followed standard methods (Wilson 2012). The sequences are freely available in the online BOLD database (http://www.boldsystems.org/; Ratnasingham and Hebert 2007), as well as the images of the specimens. The specimens information can be found in Table 1. As an outgroup we used a specimen of *Dahlica mannii,* another species of Psychidae. The neighbour-joining tree, based on the Kimura 2 parameter (K2P) model of nucleotide substitution (Kimura 1980) as recommended in the barcoding protocol (Ratnasingham and Hebert 2007, 2013) was obtained using MEGA 5 (Tamura et al. 2011). The intra- and interspecific distances are based on this analysis (Table 1).

Systematics

Pseudobankesia keersmaekersi Arnscheid & Henderickx, sp. n.

http://zoobank.org/7B7BF8DE-1FE6-40CC-BA35-0BD6676FFEB5

Material. Holotype ♂: Methana, Greece, 550 m, e.l. 6.xii.2012, leg. Henderickx.

Paratypes: 18 ♀ Methana, Greece, N 37.611348, E 23.365761, 550 m, e.l. Nov.- Dec. 2012 and 2014, leg. Henderickx.

The holotype and two paratypes will be deposited in the "Staatliches Museum für Naturkunde Karlsruhe" (SMNK), Germany. The other paratypes are deposited in the private collections of WA and M. Weidlich (Neißemünde, Germany).

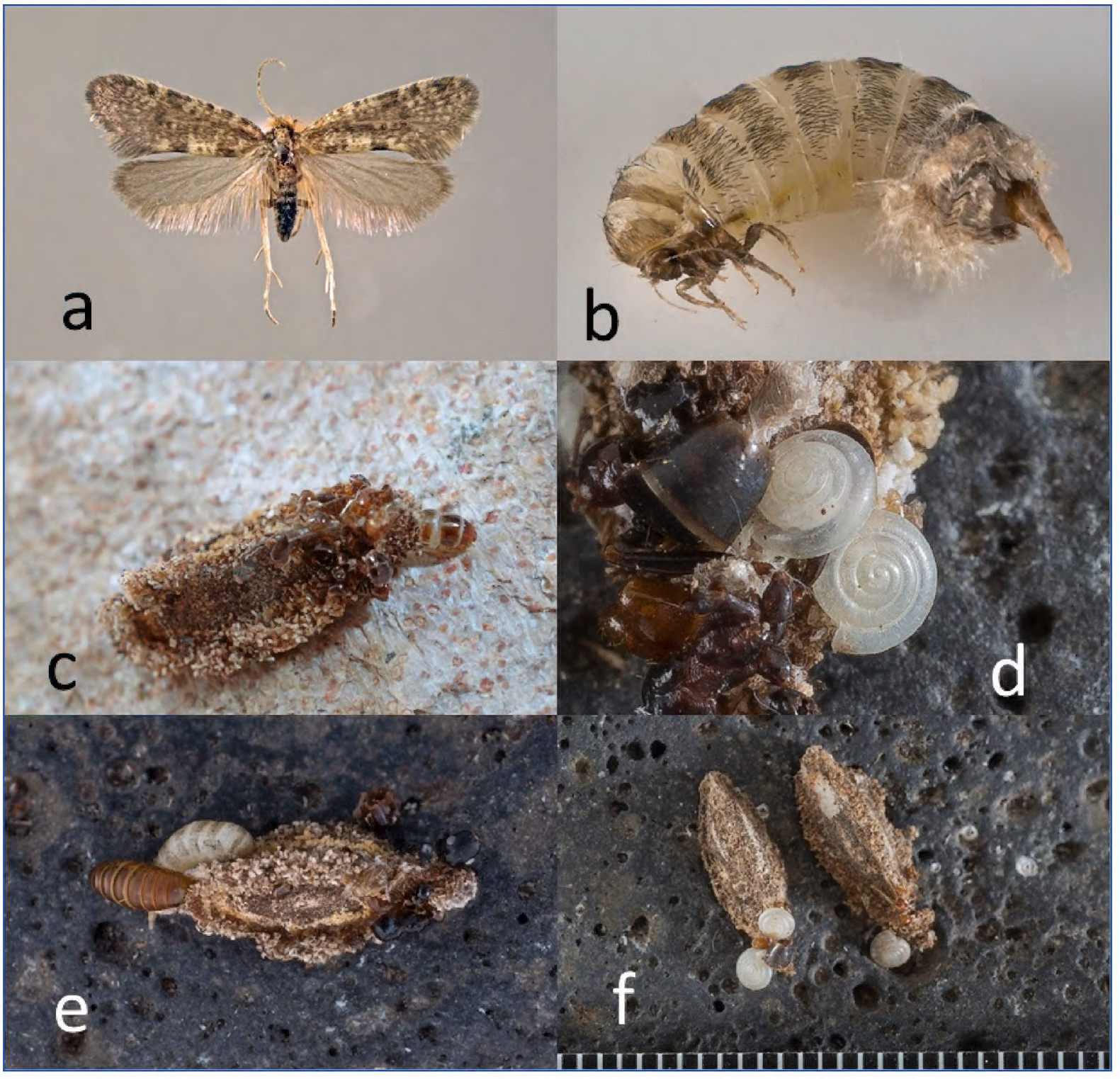

Figure 1. *Pseudobankesia keersmaekersi* sp.n. **a.** ♂ holotype; **b.** ♀ paratype; **c.** ♀ larval case; **d**. detail of case decoration with insect debris and land molluscs; **e.** ♀ on larval case; **f.** larval case decoration with land mollusks.

Etymology. We gratefully dedicate this nice new species to Jan Keersmaekers, Mol (Belgium), who joined HH on the Greek expeditions and helped collect the cases with his son Tom.

Male (Fig. 1a). Wingspan 11 mm. Head appearing hairy, frons and vertex with rough yellowish brown scales of variable length; external ocelli present; labial palp reduced to 3 segments; antenna thread-like with 26 segments; regularly short ciliated. Forewing length 5 mm; ground colour yellowish grey, basally and postdiscally with 2 broad interrupted brownish bands; at inner margin two distinct spots of ground colour; submarginally the veins with darker brownish scales forming a distinct reticulate pattern; costal margin with a series of dark brownish spots. Scales moderately broad, with 3–4 dentations (class 5 after Sauter 1956); fringe scales long, light greyish, becoming distinctly longer at the last third of inner margin; narrow, with 3-4 dentations. Hindwings uniform

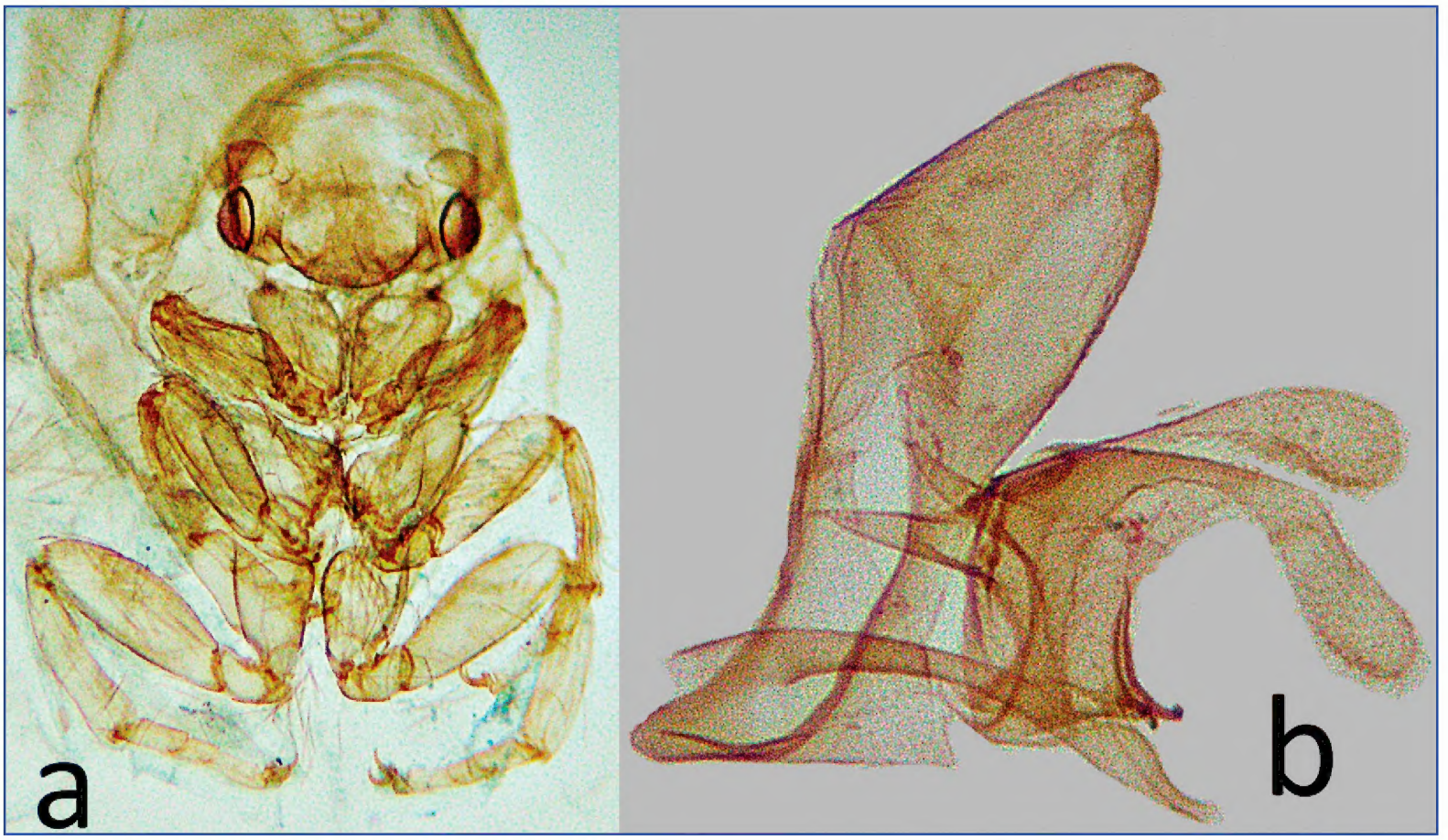

Figure 2. a. *Pseudobankesia keersmaekersi* sp.n. paratype female, head and legs after maceration in 20% KOH; **b.** male genitalia of *Pseudobankesia keersmaekersi* sp. n., holotype.

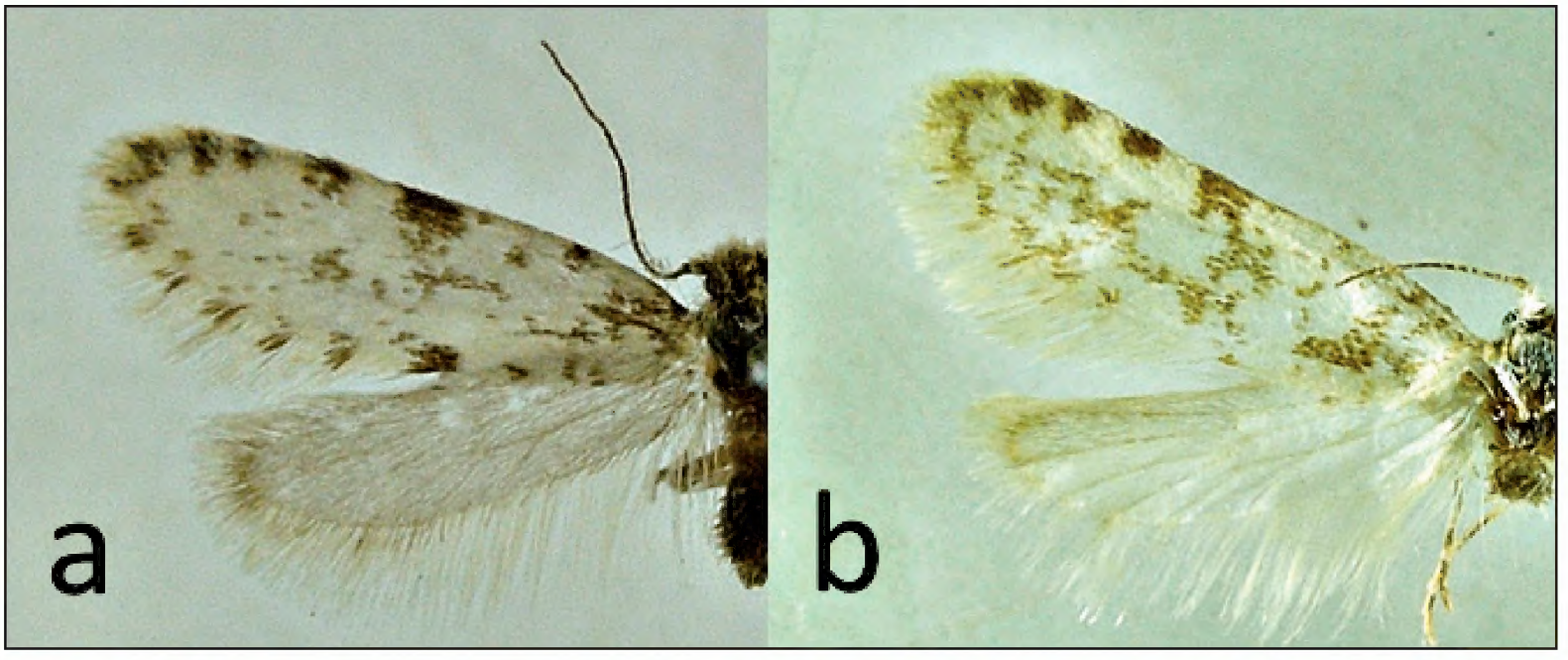

Figure 3. a. *Pseudobankesia arahova* Stengel, 1990, ♂, Greece, Sterea Ellas, Parnassos Mts., e.l. 22.v.2002, leg. Weidlich (coll. M. Weidlich); **b**. *Pseudobankesia darwinii* Stengel, 1990, ♂, holotype, Greece, Peloponnese, Mt. Helmos, e.l. 8.vi.1989, leg. Stengel (coll. Museum Witt Munich).

dark greyish, slightly glossy, scales narrow (class 2 after Sauter 1956). Venation hardly visible under magnification, with 10 veins from discal cell; accessory cell present, intercalary cell absent. Forelegs with tibial epiphysis, midlegs with one pair of apical tibial spurs, and hindlegs with medial and apical tibial spurs.

Male genitalia (Fig. 2b) typical for *Pseudobankesia* (Fig. 3), resembling the likely most-closely related genus, *Taleporia.* Tegumen conical, flat, indented distally, and with two downward-directed

Table 1. Distance matrix showing the intra- and interspecific distance between *Pseudobankesia* and *Bankesia* species based on the neighbour-joining analysis of the DNA barcode.

	PHLAG435-12_Pseudobankesia_vernella	PHLAG436-12_Pseudobankesia_vernella	POESE188-16_Pseudobankesia_keersmaekersi	PHLAB577-10_Pseudobankesia_alpestrella	TISY494-12_Pseudobankesia_casaella	PHLAH322-12_Pseudobansesia_lichenaria	TIPSY496-12_Bankesia_montanella	LEEUA045_11_Bankesia_conspurcatella	TYPSY007-08_Bankesia_conspurcatella	PHLAH323-12_Pseudobankesia_aphroditae	LEAT014-13_Pseudobankesia_kresnensis	POESE110_Dahlica_mannii
PHLAG435-12|Pseudobankesia_vernella|Piedmont_Italy												
PHLAG436-12|Pseudobankesia_vernella|Piedmont_Italy	0.02											
POESE188-16|Pseudobankesia_keersmaekersi sp.n. |Greece	0.12	0.12										
PHLAB577-10|Pseudobankesia_alpestrella|Italy	0.05	0.04	0.14									
TIPSY494-12|Pseudobankesia_casaella|Spain	0.04	0.05	0.13	0.05								
PHLAH322-12|Pseudobankesia_lichenaria|Greece	0.04	0.04	0.11	0.06	0.04							
TIPSY496-12|Bankesia_montanella|France_Corse	0.15	0.14	0.17	0.15	0.14	0.14						
LEEUA045-11|Bankesia_conspurcatella|Denmark	0.15	0.16	0.14	0.16	0.15	0.14	0.12					
TIPSY007-08|Bankesia_conspurcatella|England	0.14	0.15	0.14	0.16	0.15	0.14	0.12	0.00				
PHLAH323-12|Pseudobankesia_aphroditae|Cyprus	0.12	0.13	0.08	0.14	0.12	0.12	0.16	0.13	0.13			
LEATC014-13|Pseudobankesia_kresnensis|Bulgaria	0.13	0.12	0.07	0.13	0.13	0.12	0.17	0.13	0.13	0.09		
POESE110-16|Dahlica_mannii|Slovakia (outgroup)	0.22	0.20	0.24	0.21	0.21	0.19	0.22	0.23	0.23	0.24	0.26	

lobe-shaped sharp pointed appendages; clasper of sacculus short, broad, and with a distinctly pointed process distally; saccus often very short, but also medium-sized and pointed in other species; valva folded distally, extending beyond distal end of tegumen, more slender than in *Taleporia*, covered with hair and short spines. Phallus short and thin, curved, with setae in the distal half. Genital index (phallus length / valva length) 1.02 (n = 1).

Female (Fig. 1b). Wingless. Length 5.5–6.0 mm (excluding ovipositor), body segments creamy yellowish. Dorsally head and thorax brownish and sclerotized; each segment covered with fields of blackish hair; ventrally less sclerotized. Eyes black, very small; antenna with 13–15 segments. Anal hair-tuft undulated, yellowish grey. Legs with 2–3 tarsal segments, spur of third tibia absent or very short.

Female genitalia with antrum and antevaginal plate distinctly sclerotized, two pairs of long apophyses, lateral plates triangular, pointed, postvaginal plate indistinct.

Case. Male length 9 mm, width 3 mm, female length 9–12 mm, width 4–5 mm, distinctly triangular in cross section. Light greyish brown, sparsely covered with plant debris and sand (Fig. 1c–f). The edges of the often broad cases are mostly ornamented/accentuated with organic material, the larval opening with larger invertebrate parts (i.e. ant debris and small land molluscs). It is especially remarkable that several specimens used minute juvenile snails of the family Zonitidae to decorate the cases at the larval opening.

Based on the differentiation in the DNA barcode, *P. keersmaekersi* is well separated from the other species in the genus (Fig. 4). The nearest species is *P. kresnensis* Weidlich (2016a), with a distance of 7%.

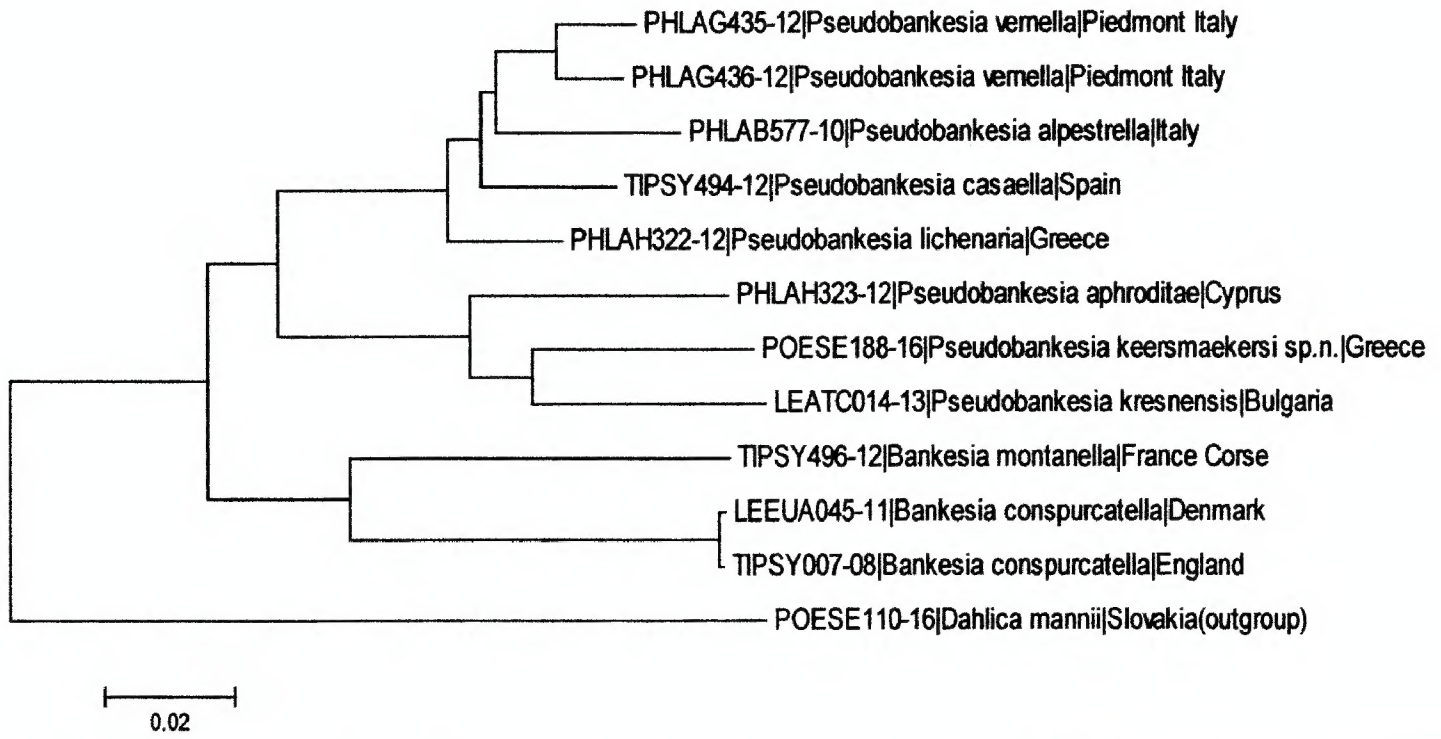

Figure 4. Neighbour-joining barcode tree showing the clustering of seven *Pseudobankesia* and two *Bankesia* species with another psychid species *Dahlica mannii* as the outgroup (scale bar = 2%).

The distances to the next closest species of the genus are 8% to *P. aphroditae* Weidlich & Hendericks (2002), 11% to *P. lichenaria* Weidlich (2016), 12% to *P. vernella* (Constant, 1899) and 14% to *P. alpestrella* (Heinemann, 1870) (Table 1). No genetic data are available for *P. arahova* Stengel (1990) and *P. darwinii* Stengel (1990). In the future, sampling of *Pseudobankesia* species should be increased to include more specimens per species, as well as other species in the genus.

Placement of the new species in *Pseudobankesia* is based on the regular ciliation of the antennae of the male. Those of the probably most-closely related genus *Bankesia* have brushes of long hairs basally on both sides of each segment. On the other hand, females of *P. keersmaekersi* sp. n. have long antennae with 13–15 segments, while those of *Bankesia* species have short antennae with only 3–6 segments. The male genitalia of *Bankesia* are very different from those of *Pseudobankesia*. They are flat in general appearance and the tegumen is narrow, conical, and slightly indented, while the genitalia of *Pseudobankesia* are much higher in lateral view and the tegumen is more or less triangular. The valvae are long and slender, much more slender than in *Pseudobankesia* and like them protrude considerably beyond the distal end of the tegumen. The clasper of sacculus is sharply extended, thorn-shaped, curved inwardly, while that of *Pseudobankesia* is short and broad with a distinctly pointed process distally. The phallus is very thin, two-thirds length of valva, almost straight and not curved as in *Pseudobankesia*, in which it is tubular and slightly enlarged caudally with setae in the distal half. Further, as far as we know, the genus *Bankesia* is distributed only in western and south-western Europe and the presence of a *Bankesia* species in Greece seems unlikely. However, recently *Bankesia cephalonica* Weidlich, 2016b, was described from an Ionian island, Kefalonia.

P. keersmaekersi is one of the larger *Pseudobankesia* species (wingspan 11 mm). The male (holotype) is distinctly characterized by its remarkable colouration and the very special wing pattern which is unique within the whole genus. Therefore, it cannot be confused with males of other *Pseudobankesia* species (Table 2). The geographically close *Pseudobankesia* species *P. darwinii* and *P. arahova* (Fig. 2a,b) differ from *P. keersmaekersi* sp.n. in the distinctly darker colouration and the remarkable female cases, which are broader.

Table 2. A comparison of morphological characteristics of *Pseudobankesia* species from south-eastern Europe.

♂	**Forewing length (mm)**	**Scales (classes)**	**Colour of head scales**	**No. antennal segments**
kresnensis	8.6–11	4–5	yellowish	29–30
aphroditae	8.5–10	4–5	brown	32–33
macedoniella	8.4–12	4–5	yellowish	26–28
arahova	9–10.2	5	whitish	26–28
darwinii	11.5–12	5–6	creamy white	29–31
hauseriella	12–12.8	4	yellowish grey	29–31
keersmaekersi	11	4–5	reddish brown	26
lichenaria	9.6–11.8	4–6	silvery grey	34–35
♀	**No. antennal segments**	**Colour of anal hair-tuft**	**No. tarsal segments**	**Spur of third tibia**
kresnensis	10–12	brownish golden	2–3	short
aphroditae	10–16	whitish grey	3–4	short
macedoniella	12–16	silvery grey	4–5	long, double
arahova	12–15	whitish	4–5	very short
darwinii	11	whitish	5	absent
hauseriella	20–23	greyish brown	5	short or absent
keersmaekersi	13–15	brown	2–3	absent
lichenaria	12	yellowish white	3–4	short, broad

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